6.—FIVE NEW MICROCOTYLIDS FROM FISH FROM WESTERN AUSTRALIAN WATERS.

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INTRODUCTION.

At the suggestion of Professor G. E. Nicholls, an investigation of local fish for new parasitic types was commenced. Fish from various localities were obtained at frequent intervals over a period of seven months, from March to September, during 1942. From the gills of five of the species of fish examined, monogenetic parasites were obtained. These all appeared, from a study of the Zoological Record, to be new species of the Genus *Microcotyle*. The outstanding features in which the parasites diverge from what seem to be the nearest related species are tabulated at the end of each described species. The study of the Zoological Record with reference to the host upon which the various species of *Microcotyle* were obtained, appears to corroborate the statement made by Brown (1929) regarding Microcotylids that "There appears to be a certain specific relationship between the parasites and their host." It is interesting to note that related parasites are usually discovered on related fish, e.g., *M. mugilis* (Vogt, 1879, according to Yamaguti, 1938), was obtained from *Mugil cephalus*, and *M. agonostomi* from *Agonostomus forsteri*. Both *M. mugilis* and *M. agonostomi* show a close relationship and their respective hosts are genera within the same family: Mugilidae. The case of *M. parasillaginae* is of interest because it has been obtained from the same host as *M. sillaginae*, viz., *Sillaginodes punctatus*. Although the two parasites are very closely related, they are certainly different species, but whereas *M. sillaginae* occurs only on fish from Victorian waters, *M. parasillaginae* is from fish from Western Australian waters.

The parasites obtained and the hosts on which they were located were:—

PARASITE.	HOST.
Microcotyle agonostomi	*Agonostomus forsteri.*
M. — arripis	*Arripis georgianus.*
M. — temnodontis	*Temnodon saltator.*
M. — parasillaginae	*Sillaginodes punctatus.*
M. — odacis	*Odax semifasciatus.*

All measurements were made from specimens mounted in balsam. The fixative which was most successful was Kleinenberg's Picric Acid. Borax carmine was found to be a reliable stain which could be used to give consistently good results. However, Cochineal Alum Carmine and Acetic Acid Alum Carmine proved to give excellent results, if carefully handled. Of the latter two, Acetic Acid Alum Carmine appeared to be the better.

In conclusion, the writer must express her thanks to the Government Fisheries Department, whose assistance in obtaining material has proved

invaluable, and, without which help, this work would have been made much more difficult. Also the writer is indebted to Professor G. E. Nicholls, whose encouragement and untiring interest in this work has been very much appreciated; and finally to Miss O. Goss, B.Sc. (Hons.), who has so readily given her assistance.

DESCRIPTION OF SPECIES.

CLASS TREMATODA.

SUBCLASS MONOGENA.

Order POLYOPISTHOCOTYLEA.

Family **MICROCOTYLIDAE** Faschenberg (1879).

Genus **MICROCOTYLE** Van Beneden and Hesse.

Microcotyle agonostomi sp. nov. (Pl. I, Fig. 1.).

Habitat: Gills.

Host: *Agonostomus forsteri.* Yellow-eyed Mullet or Pilchard.

Locality: Swan River, Mandurah, Bunbury, Denmark, Albany.

Occurrence.

From the end of March until the middle of September, 85 *Agonostomus forsteri* were examined for gill parasites and a total of 91 of these Microcotylids were obtained. Omitting the fish from which none of these parasites were recovered, the average number of parasites obtained from each fish was two. This form, *M. agonostomi,* was usually found amongst the central gill filaments of each gill bar.

Of the fish from Mandurah, it was found that the number of parasites obtained increased in number in May, June, July and August, being most abundant during the period from the latter half of July to the end of the first half of August. They then rapidly decreased in number.

General Structure.

The external appearance of *Microcotyle agonostomi* presents a squat, compact form, and is quite large in comparison with other forms of *Microcotyle.* Total length of the body averages 3.84 mm., of which 0.64 mm. is the cotylophore, which hence constitutes 1/6th of the total body length. Cotylophore is not sharply differentiated from the rest of the body. Body reaches its maximum width of 1·04 mm. at approximately the middle of the body length. Body tapers gradually to a small extent anteriorly and posteriorly. Across the genital armature the width is 0.64 mm., and at the level of the oral suckers it measures 0.32 mm. Width of the most anterior part of body is 0.288 mm. Situated 0.48 mm. from the anterior end is a conspicuous lobe on each lateral margin of the body and each averages 0.032 mm. wide and 0.112 mm. long. These lobes seem to constitute a characteristic feature for this particular species of *Microcotyle.* Width of the anterior margin of the cotylophore is 0.72 mm. and its posterior border is 0.16 mm. wide. Cotylophore carries 34 pairs of suckers each of which has the characteristic chitinous framework (Pl. I., Fig. 2). Average width of each sucker is 0.096 mm. and each is 0.048 mm. long. Oral suckers have no transverse septa, and their margins bear a series of minute simple hooks. As well as these anterior oral suckers, and the posterior suckers situated on the cotylophore, the body of the para-

site bears a pair of dorsal, sub-circular suckers, 0.72 mm. from the anterior end. Each sucker is 0.288 mm. from the lateral margin, and each has a width of 0.048 mm. and a length of 0.064 mm. Pharynx lies immediately behind the oral suckers and is followed on the ventral surface by the genital atrium with its armature consisting of three part circles of 11, 12, 11 hooks respectively. It lies 0.256 mm. from the anterior extremity of the body. Each spine is a curved structure 0.016 mm. long. This armature measures 0.064 mm. in length and 0.112 mm. in width (Pl. I., Fig 3).

Alimentary Canal.

The buccal cavity is situated at the extreme anterior end of the body and contains the pair of oral suckers. Closely following the region where these suckers are situated is the pharynx which is 0·064 mm. wide and 0·096 mm. long, and this leads into the oesophagus which has a length of 0·24 mm. This oesophagus has several lateral branches. The intestinal bifurcation immediately posterior to the genital atrium and the two longitudinal ducts run along the lateral margins of the body where they form lateral ramifications. The major longitudinal canals converge in the posterior portion of the body, and the ramifications extend 0·56 mm. into the cotylophore, even beyond the posterior extent of the vitelline follicles.

Excretory System.

Along either side of the body and ventral to the alimentary canal is a longitudinal excretory duct.

Nervous System.

The brain is rectangular and situated 0·144 mm. from the anterior end of the body. It is situated dorsally to the oesophagus. A pair of anterior nerves are present and a pair of posterior nerves pass along either side of the body.

Reproductory Systems.

Male.—There are 29 testes lying in a field surrounded by vitelline follicles, except at the anterior border. The field occupies a little less than half of the total body length. The testes fit closely into one another, thus forming a compact mass. Size of an average testis is 0·112 mm. long and 0·192 mm. wide. The vas deferens is a thick-walled tube, very much convoluted, and running on the dorsal side of the body. This terminates in the male aperture in the genital atrium.

Female.—The ovary is situated towards the posterior end of the anterior half of the body. It is a somewhat compressed form anteriorly to posteriorly. Viewed dorsally the ovary commences as a mass medianly and curves to the left side where it enlarges. It then passes to the right side by a constricted bridge, enlarges again, and passes posteriorly towards the left side again, where it is joined by the common vitelline duct. Maximum length of the ovary is 0·32 mm. Vitellarium begins at 0·288 mm. from the anterior end of the body. The lateral fields of the vitellarium meet anteriorly in the middle line. Vitellarium extends along either lateral field of the body and unites posteriorly in the cotylophore behind the testes. Vitellarium passes for 0·48 mm. into the cotylophore. Arising 0·72 mm. from the anterior end of the body, the paired ventral vitelline ducts pass posteriorly for 0·48 mm. Each duct is comparatively wide, having a maximum width of 0·096 mm.

The two ducts unite and pass posteriorly as the common vitelline duct for 0·32 mm. This joins the oviduct, and the genito-intestinal canal passes to the left. The uterus curves to the right, with the ootype and shell gland at its base, then passes anteriorly to the genital atrium as a thin-walled straight duct. Two or three eggs may be seen in the uterine duct at the same time.

Egg.

Eggs were seen both in the uterus and also after they had been laid. Each is oval in shape and at the end opposite to the operculum an appendage 0·112 mm. long is present. The extremity of this appendage bears a small hooklike arrangement (Pl. 1, Fig. 4)

Length of egg, including the tail, is 0·336 mm., so that, excluding the tail, it is 0·224 mm. Maximum width of the egg is 0·144 mm.

Summary of Specific Characters.

Average length of body—3·84 mm.

Average length of cotylophore—0·64 mm.

Average length of rest of body anterior to cotylophore—3·20 mm.

Average width of oral suckers—0·096 mm.

Average length of oral suckers—0·048 mm.

Average length of suckers of cotylophore—0·048 mm.

Average width of suckers of cotylophore—0·096 mm.

Average distance of pair of dorsal suckers from anterior end—0·72 mm.

Average width of dorsal suckers—0·048 mm.

Average length of dorsal suckers—0·064 mm.

Average distance of genital atrium from anterior end of body—0·256 mm.

Average distance vitellarium extends into the cotylophore—0·48 mm.

No. of Testes—29.

Average length of one testis—0·112 mm.

Average width of one testis—0·192 mm.

Discussion.

Paired dorsal structures apparently equivalent to the similar structures present in *M. agonostomi* have been recognised by Parona and Perugia in *M. alcedinis* and *M. canthari*, and by Brown in *M. centrodonti*. Parona and Perugia in their specimens described these structures as the paired openings of the rather wide, conspicuous, paired vaginal ducts. This view Brown is disinclined to believe, considering that Parona and Perugia have overlooked the vaginal ducts and probably their common pore. Brown stressed the single vaginal aperture, since *M. sillaginae* from Victoria, described as having paired vaginal apertures, was not then known. *M. agonostomi* has been observed in a living condition, and here the wide ducts were observed as being vitelline ducts which ran ventrally to the pair of dorsal suckers from the lateral fields of the vitellarium. From a preparation *in toto*, vaginal canals were observed to pass anteriorly from the inner margin of the vitelline ducts. Unfortunately, these could not be traced along their entire course, and hence it was not determinable whether they united to open

TABLE I.

Species.	Body Length.	Body Width.	Distance Intestine passes into Cotylophore.	No. of Posterior Suckers.	Breadth of Suckers of Coty-lophore.	Oral Suckers with or without Septa.	Size of Oral Suckers.	No. of Testes.	Size of Testes.	Hooks of Genital Armature.	Size of Spines of Genital Armature.
M. mugilis ...	6 mm. to 10 mm.	1·1 mm.	Terminates at base	25 prs.	·07 mm. to ·09 mm.	with	0·090 mm. x 0·063 mm.	40	0·112 mm.	35 hooks in complete circle.	0·02 mm.
M. agonostomi ...	3·84 mm.	1·04 mm.	0·56 mm.	34 prs.	·096 mm.	without	0·096 mm. x 0·048 mm.	29	0·112 mm. x 0·192 mm.	34 hooks as in Fig. 3.	0·014 mm. to 0·016 mm.

by a common vaginal pore or if they opened by paired pores. Probably a similar condition to this exists in *M. alcedinis* and *M. canthari*. *M. centrodonti* appears to present a different condition with the vitelline ducts connecting to the vitellarium at a considerable distance posterior to the region where the dorsal suckers occur.

General Remarks.

A specimen of *M. agonostomi* was removed alive from the gills of its host, *Agonostomus forsteri*, during the afternoon of June 16, 1942. This was placed in a dish of water from the Swan River (approximately equivalent to seawater) and it performed quite active movements. This parasite remained alive and very active for four days, and then followed a period with a marked decrease in its activity and it died on June 21, 1942. Similar experiments were performed and this was found to be the average length of time which the parasite stayed alive away from its host. On each occasion usually about twenty eggs were laid during the period the parasite lived.

Affinities.

M. agonostomi seems to find its closest relationship in *M. mugilis* (Vogt) from the gills of *Mugil cephalus*. For the comparison the description of Yamaguti (1938), was employed and also that by Parona and Perugia (1890). *Microcotyle agonostomi* seems to have a general configuration agreeing with that of *M. mugilis*, although the cotylophore of *M. agonostomi* is not distinctly demarcated as it appears to be in *M. mugilis*. However, they differ in a considerable number of details, the most important of which is the presence of dorsal suckers in *M. agonostomi*, and a divergent type of genital armature. *M. agonostomi* varies also in the conspicuous type of vitelline ducts. The further differences are best shown in Table 1.

M. agonostomi has in common with *M. alcedinis* Parona and Perugia, *M. canthari* Parona and Perugia and *M. centrodonti* Brown a pair of dorsally situated suckers in the anterior half of the body. *M. sciaenicola* Murray has a pair of genital suckers with small simple hooks. These are the only species of *Microcotyle* with such structures. However, the general shape, etc., of these species immediately eliminate them as having a close relationship with *M. agonostomi*.

Microcotyle parasillaginae sp. nov. (Pl. II, Fig. 5.).

Habitat: Gills.

Host: *Sillaginodes punctatus*, the Spotted Whiting.

Locality: Albany, Mandurah.

Occurrence.

During the period from the middle of April until the beginning of September, 1942, the gills of sixty-four *Sillaginodes punctatus* were examined, and from eight of these fish *Microcotylids* were obtained. The parasites were never found singly, the lowest number found on one fish being three and the maximum ten. Although whiting from Mandurah were examined on fifteen different occasions, only once were the parasites found, and that was on 11th July, 1942. Fish from Albany were examined only on four occasions, and on two of these, one in April and one in July, the parasites were found. This seems to indicate that the parasites are of much more frequent occurrence in Albany waters than in the Mandurah estuary.

General Structure.

Microcotyle parasillaginae is a small, elongated, slender form, having, when preserved, an average length of 2.15 mm., only in one case reaching a maximum length of 2.56 mm. Greatest width, 0.368 mm., was about half way along the body, and the body tapers gradually both anteriorly and posteriorly. Across the region of the oral suckers the width is 0.144 mm. The cotylophore, which is demarcated from the rest of the body, averages in length 0.824 mm., with the maximum being 1.12 mm., and hence occupying usually a little more than one-third of the total length. Width of the anterior margin of the cotylophore is 0·16 mm., and the width of the posterior margin 0·08 mm. The posterior suckers along either margin of the cotylophore each has a similar structure with a chitinous framework (Pl. II, Fig. 6). Altogether the number of suckers present varied from 25 to 27 pairs and in one exceptional case numbered 29 pairs. These suckers were all constantly the same size, with a width of .064 mm. and a length of 0.32 mm.

Situated within the buccal cavity are anterior oval oral suckers. Each sucker has a width of 0.08 mm. and a length of 0.048 mm., and each possesses an oblique septum. The pharynx is situated close behind the oral sucker and posteriorly to this is the genital atrium. This is 0.224 mm. from the anterior end and possesses an armature of small hooks arranged in a circlet, as well as the hooks which are situated on the penis (Pl. II. Fig. 7).

Alimentary Canal.

The anteriorly situated mouth opens into the large buccal cavity in which the oral suckers are present. This continues into the pharynx, the width of which is 0·032 mm., and the length 0.048 mm. Oesophagus passes posteriorly for 0·16 mm. and bifurcates immediately posteriorly to the genital atrium.

Nervous System.

The brain is situated dorsally to the oesophagus, shortly posterior to the pharynx region. From it a pair of anterior nerves pass anteriorly and a larger pair posteriorly.

Reproductory Systems.

Male.—There are fourteen testes situated in the posterior third of the body length, anterior to the cotylophore. These testes are subquadrangular in shape and are of a more or less constant form, the average size being .08 mm. by 0.064 mm. The vas deferens winds anteriorly as a thick-walled, wide duct, medianly situated. This terminates in a penis 0.048 mm. long, which is set round its base with several small spines. It is situated in the genital atrium which is surrounded by a small circlet of hooks.

Female.—The ovary is situated in the median field immediately anterior to the testes. It commences in a position close to the testes and passes anteriorly to form a broad curve, and passes posteriorly once again. Paired vitellaria occupy lateral fields and are 0.268 mm. from the anterior end of the parasite, and a short distance posteriorly to the genital atrium. Lateral vitelline fields extend posteriorly into the cotylophore for 0.4 mm. They unite close behind the testicular field. A pair of vitelline ducts arises on either side at 0.48 mm. from the anterior end. These ducts are 0.096 mm. long, and unite posteriorly as the common vitelline duct, 0.144 mm. long. These vitel-

line ducts have the usual Y-shape. Uterus is a thin-walled straight tube passing anteriorly in the middle field, to open into the genital atrium immediately behind the male aperture.

Summary of Specific Characters.

Average length of body—2.15 mm.
Average length of cotylophore—0.824 mm.
Average length of rest of body anterior to cotylophore—1.326 mm.
Average width of oral suckers—0·08 mm.
Average length of oral suckers—0.048 mm.
Average width of suckers of cotylophore—0.064 mm.
Average length of suckers of cotylophore—0.032 mm.
Number of suckers on cotylophore—25-27 pairs.
Average distance of genital atrium from anterior end of body—0·224 mm.
Distance vitellarium extends into cotylophore—0.4 mm.
Number of testes—14.
Average size of testes—0·08 mm. x 0·064 mm.
Length of penis—0.048 mm.
Penis bears small spines.

Affinities.

M. parasillaginae is strikingly like *M. sillaginae* in general appearance and structure. However, the sizes of the various structures were so constantly different that it was considered necessary to create the new species, *M. parasillaginae*. The penis in *M. parasillaginae* was not situated on a papilla as in *M. sillaginae*, and unlike the latter it had round its base a number of small hooks. The other differences are best shown in Table II.

Microcotyle arripis, sp. nov. (Pl. III, Fig. 8.).

Habitat: Gills.

Host: *Arripis georgianus*.

Locality: North Beach, Swan River, Mandurah, Bunbury, Busselton, Albany, Woodman's Point, Scarborough, Whitford's Beach.

Occurrence.

From April to August, 1942, 50 *Arripis georgianus* were examined for gill parasites and 51 Microcotylids were found. The average number of parasites obtained from one fish was two, that is, by not taking into consideration the fish with no parasites. The maximum number of parasites actually recovered from one fish was four. These parasites were very delicate and extremely difficult to handle. Owing to the diverse localities from which the fish were obtained, it is difficult to estimate whether or no parasites are more plentiful at any particular period of the year. However, indications seem to show that the most parasites were obtained during April and May.

Table II.

Species.	Total Length.	Length of Cotylophore.	No. of Posterior Suckers.	Size of Posterior Suckers.	Size of Oral Suckers.	No. of Testes.	Size of Penis.	Intestinal Bifurcation.	Atrium Armature.
M. sillaginae	4 mm.	Half length or more	32 prs.	0·05 mm. to 0·07 mm. in width	0·08 mm. x 0·04 mm.	11	0·027 mm. plus papilla	Anterior to genital atrium	Absent
M. parasillaginae	2·15 mm.	0·824 mm. approx. one-third length	25–27 prs	Constantly 0·064 mm.	0·08 mm. x 0·048 mm.	14	0·048 mm. no papilla	Behind genital atrium	Present

General Structure.

The parasite varies from a somewhat oval form to a more elongated shape. Average total length is 2·08 mm., with a maximum width of 0·72 mm. across about the middle of the body. Body tapers both posteriorly and anteriorly. Across the genital atrium the width is 0·24 mm., while more anteriorly, across the region of the oral suckers, it measures 0.08 mm. Cotylophore is 0·528 mm. long, thus occupying approximately a quarter of the total length. Cotylophore across its anterior margin measures 0·48 mm. and its posterior edge is 0·08 mm. wide. Cotylophore is not sharply differentiated from the body proper, but appears as a continuation which bears along its lateral margins a row of suckers on each side (Pl. III, Fig 8). Each of these is supported by a chitinous framework and they are all of a similar structure (Pl. III, Fig. 9). All these suckers are approximately of equal size on one parasite, the average size being 0·032 mm. long and 0·048 mm. wide. There are 35 pairs of these posterior suckers.

Situated within the buccal cavity is a pair of oral suckers, which are not very conspicuous. Each has a width of 0.064 mm. and a length of 0.016 mm. No transverse septum is present. Pharynx is situated very close to the oral suckers. Some little distance behind the pharynx is the ventrally situated genital atrium with its armature of spines (Pl. III, Fig 10). Width of this armature is 0·128 mm., and its length 0·08 mm. Spines of the armature are conical and 0·012 mm. in length.

Alimentary Canal.

Mouth aperture situated at the anterior end of the body and leads into the buccal cavity in which the pair of buccal suckers are situated. From this leads the circular muscular pharynx, which has a diameter of 0·048 mm., and which leads into the oesophagus posteriorly. Oesophagus has a total length of 0·256 mm., and it bifurcates a little distance behind the genital atrium, at a total distance of 0·352 mm. from the anterior end of the body. Numerous branches pass from the main lateral intestinal canals. These branches extend over the lateral fields of the body. Intestine extends for 0·24 mm. into the cotylophore.

Excretory System.

Along either side of the body is a longitudinal duct running ventrally to the alimentary canal. Each duct continues to the extreme posterior end of the body.

Nervous System.

Brain complex is rectangular in shape, enveloping the oesophagus dorsally and lying at a distance of 0.16 mm. from the anterior end of the body. Two pairs of anterior nerve cords pass forwards. Two pairs of posterior nerve cords also pass backwards, the outer pair being the better developed pair of nerves.

Reproductory Systems.

Male.—In the posterior quarter of the body, anterior to the cotylophore region are 23 testes. These are of irregular shape, and fit closely against one another, in a pavement manner. The average size of each testis

Table III.

Species.	Total Length.	Length of Cotylophore.	Number of Posterior Suckers.	Size of Posterior Suckers.	Oral Sucker with or without Septum.	Size of Atrial Spines.	Number of Testes.	Distance Vitellarium extends into Cotylophore.
M. arripis	2·08 mm.	0·528 mm.	35 prs.	0·032 mm. x 0·048 mm.	without	0·012 mm.	23	0·08 mm.
M. caudata	3·2 mm. or less	0·8 mm.	25 prs.	0·045 mm. to 0·08 mm.	with	0·01 mm.	about 23	...
M. truncata	3·3 mm.	very short	10 prs.	0·055 mm. x 0·072 mm.	?	0·13 mm.	Numerous	Extends all the way into the Cotylophore.
M. fusiformis	2·0 mm.	1 mm.	30–33 prs.	0·046 mm. x 0·065 mm.	with	0·067 mm.	about 15	Extends long way into Cotylophore.
M. sebastis	5·5 mm.	1·83 mm.	29 prs.	0·068 mm. x 0·128 mm.	with	0·017 mm.	about 40	Does not extend into Cotylophore.
M. sciaenicola	6·64 mm.	2·213 mm.	Appear to be over 40 prs.	?	?	...	Small and numerous	Extends very little into Cotylophore.

is approximately 0·048 mm. long and 0·096 mm. wide. The vas deferens is a thick-walled, fairly wide duct, which follows a sinuous course to the genital atrium.

Female.—The medianly situated ovary, when viewed dorsally, is somewhat S-shaped. It commences in a region closely applied to the most anterior testes, bends sharply on itself, and then by a winding course runs forwards, sweeps to the left and loops back to the right. The course it then traces is dorsally situated to the first portion. It passes back and joins the common vitelline duct. Maximum length of the ovary is 0·368 mm. Vitellarium commences 0·352 mm. from the anterior end of the body. It occupies both lateral fields and extends for 0·32 mm. into the cotylophore, where the two sides join, posteriorly to the testes. At 0.80 mm. from the extreme anterior end of the body, there arises from each lateral vitelline field a vitelline duct. Each of this pair of vitelline ducts passes for 0·24 mm. posteriorly, and then they unite into a common vitelline duct, 0·152 mm. long. In the region where the oviduct and common vitelline duct join, the genito-intestinal canal passes into the intestine. The receptaculum seminis is formed soon after the union of the oviduct and common vitelline duct. The uterus passes anteriorly as a thin-walled duct, situated in the central field, and proceeds straight to the genital atrium.

Egg.

The egg was seen only in the uterus, but the measurements made here were—length of egg 0·224 mm.; maximum width of egg 0·08 mm.; length of the longer appendage 0·48 mm. approximately; length of the shorter appendage 0·08 mm. approximately.

Summary of Specific Characters.

Average length of body—2·08 mm.
Average length of cotylophore—0·528 mm.
Average length of rest of body anterior to cotylophore—1·452 mm.
Average length of oral suckers—0·064 mm.
Average width of oral suckers—0·016 mm.
Number of suckers on cotylophore—35 pairs.
Average width of suckers on cotylophore—0.048 mm.
Average length of suckers on cotylophore—0.032 mm.
Average distance of genital atrium from anterior end of body—0.24 mm.
Distance vitellarium extends into cotylophore—0.08 mm.
Number of testes—23.
Average length of testis—0.048 mm.
Average width of testis—0.096 mm.

Affinities.

Microcotyle arripis appears to be most nearly related to *M. caudata* Goto, *M. truncata* Goto, *M. fusiformis* Goto, *M. sebastis* Goto, *M. sciaenicola* Murray. Although showing no marked affinities with any of these, the closest relationship seems to be between *M. arripis*, *M. fusiformis* and *M. truncata*. The tabulated comparisons (Table III) clearly show the difference in these forms.

Microcotyle temnodontis sp. nov. (Pl. IV, Fig. 12.).

Habitat: Gills.

Host: *Temnodon saltator.*

Locality: Mandurah, Albany, Swan River, Bunbury.

Occurrence.

From April to August, 1942, 47 fish were examined and from their gills 148 Microcotylids were obtained. The average number of parasites for one fish was 3. The majority of fish obtained in the period were from Mandurah, and of these the parasites seemed to be most plentiful in June and July, with a sudden diminishing in abundance in August.

General Structure.

The parasite has an elongated form, being 2.72 mm. long and having a maximum breadth of 0·4 mm., at about centre of body and tapering gradually both anteriorly and posteriorly. Towards the anterior end, the body width is, in the region of the genital armature 0·152 mm. and across the region of the oral suckers 0.112 mm. wide. Cotylophore, which is distinctly demarcated from the rest of the body, is 0.72 mm. long, and across its most anterior border measures 0.4 mm., while the width of the posterior edge is 0·08 mm. Cotylophore occupies almost one-quarter of the total body length, the rest of the body having a length of 2.0 mm. Along either lateral border of the cotylophore is a row of suckers, each of which is of a similar structure and has a chitinous framework, as seen in (Pl. IV., Fig. 13). There are altogether 55 pairs of these posterior suckers and the average size of each is 0.016 mm. long and 0.032 mm. wide.

Lying in the buccal cavity at the anterior end of the body is a pair of conspicuous, practically circular oral suckers with a diameter of 0.048 mm. These suckers do not possess transverse septa. Lying closely behind the oral suckers is the pharynx and posteriorly again to this is the genital atrium with its conspicuous armature of simple spines (Pl. IV., Fig 14). Genital armature is 0.08 mm. in diameter and lies entirely on the ventral surface. Spines of the genital armature are conical, being 0.008 mm. long.

Alimentary Canal.

At the anterior end of the body is the mouth, opening into a large buccal cavity containing the oral suckers. Leading from this is the oval pharynx 0·032 mm. long and 0·08 mm. wide, and this passes directly into the oesophagus which runs posteriorly for 0.24 mm., and the intestinal bifurcations diverge posteriorly to the genital armature, and at a total distance of 0·336 mm. from the anterior end of the body. From the main lateral intestinal canals are numerous ramifications, these being most obvious in the outer fields. The ramifications extend 0.08 mm. into the cotylophore.

Excretory System.

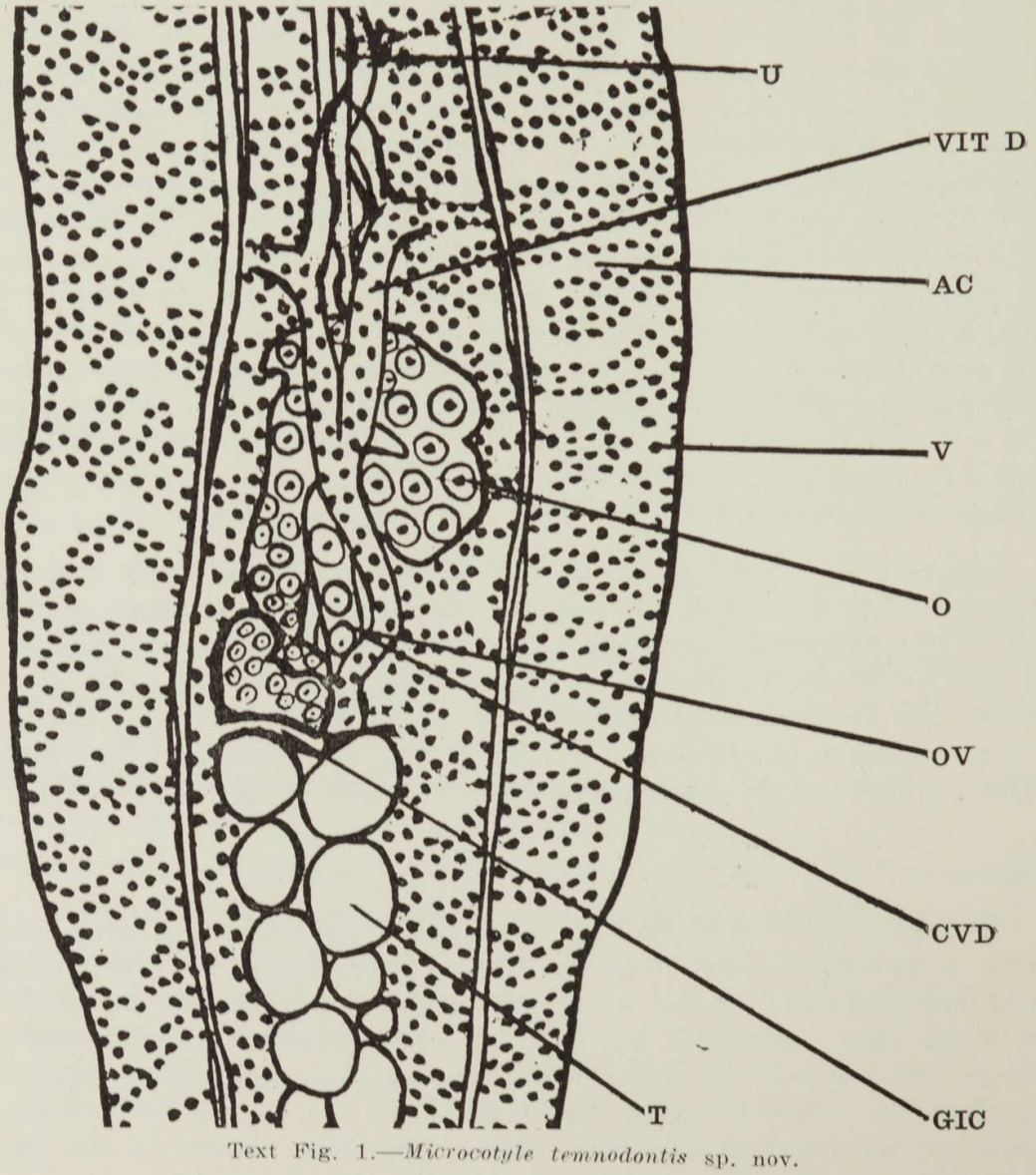
A main longitudinal duct runs along either side of the body ventrally to the intestinal canals. Each duct passes to the extreme posterior end of the cotylophore.

Nervous System.

The brain is a rectangular shaped structure 0·128 mm. from the anterior end of the body, dorsal to the oesophagus. A pair of anterior nerve cords arises from the front of the brain, and from the posterior edge arises a pair of posterior longitudinal nerve cords.

Reproductory Systems.

Male.—There are 21 testes, all of a circular to subcircular shape. These are situated in a field 0·48 mm. long in the posterior quarter of the body anterior to the cotylophore and between the vitellaria. The testes follicles at the anterior end are the larger, being on the average 0.064 mm. in diameter, while towards the posterior end each has a diameter of only 0.048 mm. The vas deferens is a wide, thick-walled duct tracing a sinuous course anteriorly, to open into the genital atrium.



Text Fig. 1.—*Microcotyle temnodontis* sp. nov.

Female.—The ovary, which is median in position, commences close to the most anterior testes, passes forwards towards the right, swings to the left and curves slightly, and then passes straight back to be joined by the common vitelline duct. The single dorsal vaginal pore is best seen while the parasite is alive, and it lies immediately posterior to the genital armature, in the middle line. It has no armature around its aperture. Paired vaginal

Table IV.

Species.	Body Length.	Length of cotylophore.	No. of Posterior Suckers.	Breadth of Suckers of cotylophore.	Oral Suckers with or without septa.	No. of Testes.	Size of spines of genital armature.
M. temnodontis	2·72mm.	0·72mm.	55prs.	0·032mm.	without	21	0·008mm.
M. australiensis	4·00mm.	1·40mm.	Diagram shows as numerous	?	?	25	?
M. sebastis	5·50mm.	1·83mm.	29 prs.	0·068mm. to 0·128mm.	with	40	0·017mm.
M. elegans	4·00mm.	1·30mm.	50 prs.	0·040mm. to 0·068mm.	with	27	0·005mm.
M. victoriae	4·82mm.	1·20mm. approx.	21 prs.	?	with	18–22	0·005mm. to 0·009mm.
M. hiatulae	3·50mm.	...	23 prs.	?	?	15	0·015mm. to 0·018mm.

canals join the vitelline ducts and run anteriorly for a short distance and unite to form a median duct leading to the vaginal pore. Vitellarium begins 0·32 mm. from the anterior end of the body and occupies both lateral fields and extends into the cotylophore for 0.08 mm. At 1.12 mm. from the anterior end of the vitellarium a vitelline duct arises on either side. These ducts form the typical Y-shape. Each of the paired ducts is 0.08 mm. long, and they join in the middle line and pass posteriorly for 0.16 mm. as the common vitelline duct. It joins the oviduct and the genito-intestinal canal passes to the right intestinal branch. The uterus is a thin-walled straight tube situated in the central field, lying dorsally to the vitelline ducts and passing forwards to open into the genital atrium. (Text Fig. 1.)

Egg.

The eggs of *Microcotyle temnodontis* are very elongated, being 0.294 mm. long and having a maximum width of 0.042 mm. Each has a very long filament at either end, that of one end being 1.105 mm. long and that of the other end approximately 0·42 mm. long (Pl. IV., Fig. 15).

Summary of Specific Characters.

Average length of body—2.72 mm.
Average length of cotylophore—0.72 mm.
Average length of rest of body anterior to cotylophore—2.0 mm.
Average diameter of oral suckers—0.48 mm.
Average length of suckers of cotylophore—0.016 mm.
Average width of suckers of cotylophore—0.032 mm.
Number of suckers on cotylophore—55 pairs.
Average distance of genital atrium from anterior end of body—0.288 mm.
Distance vitellarium extends into cotylophore—0.08 mm.
Number of rounded testes—21.
Average diameter of testes—0.056 mm.

General Remarks.

A specimen of *M. temnodontis* was removed from the gills of its host, *Temnodon saltator* in the afternoon of June 23, 1942. Since it showed signs of life it was placed in a dish of water from the Swan River (approximately equivalent to seawater). This specimen was still alive in the late afternoon of June 24, 1942, but it died some time during the ensuing night. This specimen laid approximately 20 eggs. From the manner in which the eggs stayed attached to the parent it seemed that, if the eggs were produced while the parasite was still attached to the host, the eggs could possibly stay fixed somewhere in the gill chamber, until they hatched. The average length of time which these parasites lived after being detached from their host and placed in river water, as above, was 1½ days.

Affinities.

Woolcock (1936) related *Microcotyle victoriae* to the group of Microcotylids:—*M. australiensis* MacCallum (1931), *M. sebastis* and *M. elegans* Goto (1895); *M. bassensis* Murray (1931) and *M. hiatulae* Goto (1899). It appears that *M. temnodontis* is closely related to this group.

Several of these species, in general appearance, rather closely resemble *M. temnodontis*, but differences in length and the measurements, etc., of various parts occur, as is shown in the Table IV.

Microcotyle odacis, sp. nov. (Pl. V, Fig. 16.).

Habitat: Gills.

Host: *Odax semifasciatus*, Weedy Whiting.

Locality: Albany.

Occurrence.

The material used for this description was obtained from Albany in April, 1941. About 15 specimens were obtained from three fish at the one examination. Hence it seemed that the parasites were of frequent occurrence in this locality, at this particular period.

General Structure.

Microcotyle odacis is an elongated form, being symmetrical and having uniformly smooth margins. Average length is 3.28 mm. and the maximum width is 0.512 mm. at about the middle of the length. Across the genital atrium region the width is 0.224 mm., while across the oral sucker portion it measures 0·144 mm. For the posterior quarter of its length, the cotylophore, which is 0.88 mm. long, is distinctly separated from the rest of the body. Cotylophore tapers gradually posteriorly, being approximately the shape of an elongated triangle. Its anterior margin measures 0.432 mm., and the posterior is 0.128 mm. wide. Along each lateral margin it bears a series of small suckers which number 28 on the right side and 30 on the left side. These suckers are all of a similar structure, and each is supported by a chitinous framework (Pl. V., Fig 17). All the suckers of the cotylophore are of approximately equal size, being 0·064 mm. wide and 0.048 mm. long.

At the anterior end of the body, in the buccal cavity, is a pair of muscular suckers 0.08 mm. in diameter. Each of these suckers possesses a transverse septum, which is obliquely placed to the longitudinal axis of the body of the parasite. Situated closely behind the oral suckers is the pharynx, which has a diameter of 0.048 mm. On the ventral surface, 0.272 mm. from the anterior end, is the genital atrium with its armature of small simple hooks, each 0.016 mm. long. This genital armature has a maximum width of 0·112 mm. and a maximum length if 0·112 mm. (Pl. V., Fig. 18).

Alimentary Canal.

At the anterior end of *Microcotyle odacis* is the mouth which opens into the large buccal cavity, from which passes the subcircular pharynx with a diameter of 0.048 mm. This continues into the oesophagus which has a total length of 0.24 mm. The intestinal bifurcation occurs immediately posterior to the genital atrium and 0.40 mm. from the anterior end of the body. The main longitudinal intestinal canals then pass along each lateral field and numerous side branches are given off on both sides. These branches pass into the cotylophore for 0·312 mm.

Nervous System.

At 0.208 mm. from the anterior end of the body, the brain is situated above the oesophagus. From this brain a pair of small anterior nerves passes to the front of the body, while posteriorly a pair of longitudinal nerves is given off as well as an outer pair of shorter nerves.

Reproductory Systems.

Male.—There are 14 testes with an average size of 0·112 mm. by 0·096 mm., which are situated in a paired manner in the posterior region of the body, and occupying a little more than a quarter of the length of the body (omitting the cotylophore). The testes lie completely within a field enclosed by the vitellaria. The vas deferens passes forwards and the male genital pore is situated in the genital atrium.

Female.—The ovary is situated in the median field immediately anterior to the testes. The ovary has its origin here and passes forwards and curves round to pass posteriorly again. Total length of the ovary is 0.32 mm. Vitellaria are situated laterally, being present 0.448 mm. from the anterior end of the body, where the lateral fields converge. These fields meet posteriorly behind the testes and extend for 0·312 mm. into the cotylophore. The transverse vitelline ducts commence at 0.96 mm. from the anterior end of the vitelline follicles and pass posteriorly as paired ducts for 0·112 mm. and they join as the common vitelline duct which runs backwards for 0.16 mm. Thus the typical Y formation of the vitelline ducts is formed. The genito-intestinal canal communicates with the right intestinal canal. In the median field the thin-walled uterus passes anteriorly to open in the genital atrium.

Egg.

This was seen only in the uterus. It has an oval form with appendages at both poles. Each egg has a length of 0.152 mm. and a maximum width of 0.096 mm. The appendages are approximately 0.128 mm. and 0.848 mm. long respectively. (Pl. V., Fig. 19).

General Remarks.

The specimens were received in a preserved condition and not collected fresh by the author.

Summary of Specific Characters.

Average length of body—3.28 mm.

Average length of cotylophore—0.88 mm.

Average length of rest of body anterior to cotylophore—2.40 mm.

Average diameter of oral suckers—0·08 mm.

Number of suckers on cotylophore—28.30.

Average length of suckers on cotylophore—0.048 mm.

Average width of suckers on cotylophore—0.064 mm.

Average distance of genital atrium from anterior end of body—0·272 mm.

Distance vitellarium extends into the cotylophore—0.312 mm.

Number of testes—14.

Average size of testes—0.112 mm. by 0.096 mm.

Table V.

Species.	Total Length.	Length of Cotylophore.	Number of Posterior Suckers.	Size of Posterior Suckers.	Oral Sucker with or without Septum.	Size of Atrial Spines.	Number of Testes.	Distance Vitellarium passes into cotylophore.
M. odacis	3·28mm.	0·88mm.	28 and 30	0·048mm. x 0·064mm.	with	0·016mm.	14	0·312mm.
M. elegans	4·00mm.	1·30mm.	50 prs.	Breadth 0·040mm. to 0·068mm.	with	0·005mm. conical	27	Extends into cotylophore.
M. bassensis	5·80mm. to 6·30mm.	1·90mm. to 2·10mm.	50–55 pairs	2 rows	with 2 rows minute hooks	0·009mm.	30–36 small	Extends into cotylophore.
M. australiensis	5·60mm.	1·86mm.	Not stated. Appears to be over 50 pairs.	...	...	...	8–9 unpaired	Extends into cotylophore.
M. pagrosomi	5·20mm.	1·73mm.	Not stated. Appears to be over 50 pairs.	...	with 1 row minute hooks	...	small and numerous	One lateral field extends into cotylophore.

Affinities.

M. odacis seems to be quite a distinct form, bearing no very close relationship to any other species. The species of *Microcotyle* most nearly allied to *M. odacis* appear to be *M. elegans* Goto, *M. bassensis* Murray, *M. australiensis* Murray, and *M. pagrosomi* Murray. However, even from these forms, *M. odacis* is very distinct in various features. These divergencies are best shown in Table V.

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KEY TO LETTERING OF FIGURES.

A.N.C.	Anterior Nerve Cord.	O.S.H.	Hooks of Oral Sucker.
B.	Brain.	Ov.	Oviduct.
B.C.	Buccal Cavity.	P.	Penis.
C.	Cotylophore.	Ph.	Pharynx.
C.V.D.	Common Vitelline Duct.	P.N.C.	Posterior Nerve Cord.
D.S.	Dorsal Sucker.	P.S.	Posterior Sucker.
E.	Egg.	R.S.	Receptaculum Seminis.
E.C.	Excretory Canal.	S.O.	Shell Gland and Ootype.
G.A.	Genital Atrium.	T.	Testes.
G.H.	Genital Hook.	T.S.	Transverse Septum.
G.I.C.	Genito-Intestinal Canal.	U.	Uterus.
I.	Intestine.	V.	Vitellarium.
L.P.	Lateral Projection.	V.C.	Vaginal Canal.
M.	Mouth.	V.D.	Vas deferens.
O.	Ovary.	Vit. D.	Vitelline Duct.
Oes.	Oesophagus.	V.P.	Vaginal Pore.
O.S.	Oral Sucker.		

EXPLANATION OF PLATE I.

Microcotyle agonostomi, sp. nov.

Fig. 1.—Whole specimen.

Fig. 2.—Posterior Sucker Skeleton.

Fig. 3.—Armature of Genital Atrium.

Fig. 4.—Egg.